Table 15
Individual Control Strategies
Disapproved as of June 2, 1989 and Current Status

Point Source	Waterbody	KPDES Permit No.	Current ICS Status
Campbellsville STP	Little Pitman Cr.	KY0054437	Draft permit; if permit is issued by 2/4/91 as drafted, the ICS would be acceptable
Elizabethtown STP	Valley Creek	KY0022039	Final permit issued; acceptable ICS
Madisonville STP	Unnamed trib. & Flat Creek	KY0022942	Final permit issued; acceptable ICS
Corbin STP	Lynn Camp	KY0020133	Final permit issued; acceptable ICS
Hopkinsville Northside STP	North Fork Little River	KY0023388	Final permit issued; acceptable ICS
Jeffersontown STP	Chenoweth Run	KY0025194	Final permit issued; acceptable ICS

Public Health/Aquatic Life Impacts: Non-toxics

Non-toxics are conventional pollutants such as chlorine, un-ionized ammonia, oxygen demanding substances, and pathogenic organisms such as bacteria and viruses. These pollutants are a cause of concern because they are often responsible for fish kills, or like bacteria and viruses, can pose a threat to human health. Reports on fish kills, bacteriological evaluations of streams, and beach closures are discussed below.

Fish Kill Incidents

Forty-two fish kill reports were received by KDFWR between January 1, 1988 and December 31, 1989. These involved slightly more than 153 stream miles and nine surface acres on 35 different waterbodies. Fourteen major causes were identified, with organic enrichment by wastewater treatment plants (WWTPs) or animal wastes, and petroleum-related pollution being predominant (33%). Over 541,000 fish valued at approximately $133,000 were estimated to have been killed. The single largest fish kill during this period was caused by a thermal discharge to the Green River. Almost half (20) of the fish kills investigated occurred in July, August, and September. Table 16 summarizes the severity, causes, and locations of fish kills during 1988-89. Appendix B shows a more detailed list of the fish kills which were investigated.

Table 16
Fish Kill Summary

		Number Reported 1988	1989	Total
Severity:	Light (<100)	0	0	0
	Moderate (100-1,000)	8	5	13
	Major (>1,000)	10	9	19
	Unknown	1	9	10
	Total	19	23	42
Cause:	Sewage (WWTP)	4	7	11
	Agricultural operation	1	2	3
	Mining or oil operation	2	1	3
	Oil or chemical spill	3	2	5
	Natural (low D.O., etc.)	4	3	7
	Misc. (sediment, heated water, etc.)	2	3	5
	Unknown	3	4	7
	Total	19	23	42
River Basin:	Big Sandy			
	Licking			
	Kentucky	7	7	14
	Salt	1	4	5
	Green	3	3	6
	Upper Cumberland	1	2	3
	Lower Cumberland	0	0	0
	Tennessee	0	1	1
	Ohio tributaries	7	6	13
	Total	19	23	42
Approximate number of stream miles		105.6	47.8	153.3
Approximate acres of lakes		0	9	9
Estimated number of fish killed		319,212	222,330	541,542

A ten year synopsis (1980-89) of fish kill records is shown in Table 17. During this period, the number of major (>1000 fish) fish kills occurring each year has remained fairly low ($\leq$10). For the current 305(b) reporting period (1988-89), the number of fish kills recorded (42) and the number of waterbodies affected (39) are lower than the previous four 305(b) reporting periods; however, the number of stream miles affected (153.34) and the number of fish killed (541,542) are higher than in previous periods.

Table 17
Fish Kill Synopsis, 1980-1989

Year	Number of Incidents	Number of Water-bodies	Stream Miles Affected	Surface Acres Affected	Number Fish Killed	Number Major Fish Kills*	Known Causes
1979	15	15	NR	NR	NR	NR	5
1980	24	25	53.21	-	224,163	10	10
1981	26	30	74.33	-	81,266	7	10
1982	26	28	51.95	42-103	98,436	5	12
1983	36	41	51.32	7.0	76,187	8	19
1984	33	35	67.28	47.5	106,514	7	18
1985	29	27	86.88	4.5	59,499	5	9
1986	23	20	23.34	47.0	129,560	8	9
1987	30	32	58.29	200.0	229,583	10	14
1988	19	16	105.56	-	319,212	10	10
1989	23	23	47.78	9.0	222,330	9	11
Total	-	-	619.94	418.0	1,546,750	79	-

*>1000 fish killed
NR = Not Recorded

Bacteriological Evaluations of Recreation Uses

During the 1988 - 1989 recreation seasons, bacteriological surveys were conducted in the areas listed below. Fecal coliform, fecal streptococci, and Escherichia coli (E. coli) bacteria are measured in water samples as indicators of other disease-causing bacteria. The most common illnesses experienced from swimming in fecally polluted waters are gastroenteritis, ear infections, and skin infections (swimmers itch).

- Little River Basin
- Brooks Run, Jefferson County
- Kentucky River at Frankfort
- Big Sandy River Basin
- Yellow Creek
- Elkhorn Creek River Basin
- Kentucky River at Fort Boonesborough State Park.

The Little River and Yellow Creek bacteriological surveys were part of an intensive survey. The Big Sandy River and Elkhorn Creek basins were surveyed as a result of these streams being reported as not supporting primary contact recreation (PCR) use in the 1986 305(b) Report. The Kentucky River at Fort Boonesborough State Park was surveyed at the request of the Department for Human Resources in response to closing the beach because of fecal coliform contamination. Brooks Run was surveyed as a result of media concern over its use for baptisms. Other surveys were conducted as a result of enforcement action or complaint investigations. Primary contact recreation use support was evaluated using the following criteria: if the geometric mean (GM) of the fecal coliform (FC) counts from a minimum of five samples was above 200 colonies / 100 ml, or if less than five samples from a site were collected and any counts were above 400 colonies / 100 ml, the use was not supported. The results from the above evaluations were incorporated into the use support assessments reported in this chapter.

Beach Closures

During the 1988 - 1989 PCR seasons, beaches were closed at three state parks by the Department of Parks. They were:

- **July 9, 1988** — **Fort Boonesborough State Park. Closed for the season due to drought conditions and bacterial contamination.**
- **July, 1988** — **John James Audubon State Park. Closed due to bacterial contamination.**

- o June 23, 1989 Greenbo Lake State Resort Park. Closed for the season due to bacterial contamination.

- o July 27, 1989 Fort Boonesborough State Park. Closed for the season due to bacterial contamination.

Wetland Information

Wetlands are among the most beneficial and productive ecosystems in the world, with numerous integral functions and values, although historically they have been regarded as wastelands. Wetlands have been described as "kidneys of the landscape" because of their functions in hydrologic and chemical cycling of wastes. A summary of wetland functions and values include: (1) flood storage capacity, (2) flood conveyance, (3) sediment control, (4) biological nutrient source, (5) water quality enhancement, (6) groundwater recharge, (7) habitat for wetland flora and fauna, (8) recreation, (9) education and scientific research, (10) timber and food production, (11) abating pollution, and (12) aesthetics and open space. Because the public is beginning to realize the importance of wetlands, especially to flood storage and water quality, regulatory agencies are being asked to do more to protect these valued resources.

Wetlands are defined as land that has a predominance of hydric soils and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions. Therefore, three criteria are required to identify wetlands: (1) hydrophytic vegetation, (2) hydric soils, and (3) hydrology. The problem with determining the boundaries of a regulated wetland typically lies in the transition between wetland and upland where identifying all three criteria can be difficult. The DOW participates with the U.S. Army Corps of Engineers (COE) in jurisdictional delineations, and adheres to the 1989 Federal Manual for Identifying and Delineating Jurisdicational Wetlands, which is a joint interagency publication by the COE, U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (EPA), and U.S. Soil Conservation Service.

According to the most recent (1979) USFWS classification system, the majority of Kentucky's wetlands fall in the Palustrine System. Areas lying shoreward of rivers and lakes, including floodplains, oxbows, ponds, marshes, and swamps are members of the Palustrine System. The broad alluvial floodplains of the Ohio and Mississippi rivers and their tributaries in western Kentucky comprise the vast majority of Kentucky's wetlands. The class type within these floodplain areas is mostly bottomland hardwood forests with inclusions of scrub-shrub and emergent types of vegetation. Small ponds are common throughout the state and their area is difficult to assess. However, ponds have important value as ecological epicenters.

The Riverine System includes all wetlands and deepwater habitats contained within a channel that experiences continuously or periodically moving water or connects two bodies of standing water. While wetlands of this type are not extensive in Kentucky, they provide a unique habitat for many rare or endangered species, sustain the hydrology for Palustrine Systems, and convey flood waters.

Lacustrine Systems, such as deep water habitats in lakes, are the least ecologically significant type of Kentucky wetland. These systems are limited in Kentucky to man-made lakes, their shorelines, and spillways.

The loss of valuable wetland resources, and adverse impacts to remaining areas, are of special concern to Kentucky. Over half of the original wetland acreage has been destroyed. Nearly all of the areas that remain have been degraded by pollutants, such as pesticides, acid mine drainage, siltation, brine water, and/or domestic and industrial sewage. However, Kentucky still does not have an active wetland monitoring program. There continues to be a poor understanding of what once occurred, what is left, and current impacts and rates of loss.

Nonpoint source impacted wetlands, which were identified in the 1989 Kentucky Nonpoint Source Pollution Assessment Report, will be compiled and listed for distribution. This list will be provided to appropriate regulatory and non-regulatory agencies for the purpose of exchanging data, and for encouraging agencies to increase education and regulatory efforts in those areas. Land owners will be encouraged to implement best management practices designed for surface waters in protecting and/or abating nonpoint source impacts to wetlands areas.

Few wetland studies have been conducted in Kentucky, although extensive wetland systems occur in the Jackson Purchase area and western coalfields. One of the most significant wetland studies was made by Mitch et al. (1982), which included wetland classification, mapping, ecosystem modelling, and wetland management in the western coalfield region of the state. Their analysis clearly revealed that coal mining and oil extraction affected the health of wetlands in the coalfield region. Also, other activities, such as logging, channelization, and impoundments have significantly altered those wetlands. The major threats to Kentucky's wetlands are competing land use activities and poor land management practices.

In 1985, the DOW provided funding to the Kentucky State Nature Preserves Commission to determine the status of Kentucky's wetlands. Recommendations for protection of remaining wetland areas were included in their 1986 report Wetland Protection Strategies for Kentucky. Among their findings was an estimate that, as of 1978, 58 percent, or 929,000 acres, of the original 1,566,000 acres of wetland soils in Kentucky had been drained. Further, it was estimated that only 20 percent of Kentucky's wetland soils remain forested, which reflects a dramatic decline in bottomland hardwood wetlands. The Kentucky Department of Fish and Wildlife Resources estimates Kentucky's annual rate of wetland loss at 3,600 acres. This information only provides a rough estimate of Kentucky's wetland trends. More detailed analyses will be available at the conclusion of a current wetland mapping project. Under the USFWS National Wetlands Inventory, all of Kentucky's wetlands will be mapped by 1991.

Currently, in cooperation with the COE and the EPA, Kentucky has begun an Advanced Identification (ADID) study under Section 230.80 of the 401(b)(1) Guidelines to collect information on the natural value of wetlands in the western coalfield region of Kentucky. The study area includes the four counties of Butler, Hopkins, Muhlenberg, and Ohio. The general objectives of ADID are to identify wetland sites with areas of high ecological value, which are in need of protection from future fill activities, and areas of low ecological value, which could serve as potential future disposal sites. The information gathered in the field and office will be used to produce maps depicting wetlands that are suitable or unsuitable for mining activities.

Kentucky has assumed primacy for all programs of the Clean Water Act (CWA) with the exception of Section 404, the Dredge and Fill Permit Program. Under Federal requirements, total authority for the 404 program cannot be extended to the states since the COE retains jurisdiction over activities in "traditionally navigable

waters". The phrase "navigable waters" is defined as waters which are presently used, have been used, or may be susceptible to use in transporting interstate or foreign commerce, which includes areas subject to the ebb and flow of the tide, shoreward to the mean high water mark. Under the terminology of the Federal regulations, "navigable waters" is also known as "Phase I Waters", and the actual determining of Phase I Waters is made by the COE.

Waterbody areas, known as Phase II and III Waters, which are not regarded as "navigable waters" by the COE, could be administered by the state. Phase II Waters include tributaries and adjacent wetlands associated with Phase I Waters. Phase III Waters are the remainder of the waters of the state up to the headwaters. The state is allowed to assume jurisdiction over these areas. The DOW has studied the feasibility of administering the Dredge and Fill program, but concluded that the state lacked the necessary funding and staff to assume primacy. However, should funding become available, the Division is the logical state agency to assume the program.

Currently, wetland protection legislation does not exist for Kentucky. Kentucky water quality standards regulations include wetlands as waters of the Commonwealth, but do not provide specific wetlands criteria. Under these regulations, three of Kentucky's wetlands have been proposed as outstanding resource waters. Since wetlands are listed as waters of the Commonwealth within the regulations, they are designated for all uses until specifically designated otherwise. The Division has recently added the wetlands definition cited above to the proposed water quality standards.

Under Section 401 of the CWA, the Division is applying applicable water quality standards to wetlands. Section 401 states that "any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State ... that any such discharge will comply with the applicable (water quality) provisions ...". Chapter 224 of the Kentucky Revised Statutes and Title 401, Chapter 5, Kentucky Administrative Regulations provides that the Natural Resources and Environmental Protection Cabinet has the authority to regulate the discharge of pollutants into any of the waters of the Commonwealth, including wetlands, and is the Section 401 "certifying agency". Title 40, Code of Federal Regulations, Part 121 provides that the certifying agency may place "any conditions which are deemed necessary or desirable with respect to the discharge or the activity." The Division has prepared a grant proposal to EPA Region IV to develop specific 401 implementing regulations. Such regulations would enhance wetlands protection at the state level.

Through the coordinated state review process for Section 404 and Section 10 activities, the Department for Environmental Protection provides all resource agencies within state government an opportunity to comment on proposed activities within regulated waters, including wetlands. The Department will consider all comments and formulate a final, coordinated response, on behalf of the Governor, to the COE. Typically, DOW and the Kentucky Department of Fish and Wildlife Resources provide detailed comments on projects that may impact wetlands.

CHAPTER 2

WATER QUALITY ASSESSMENT OF LAKES

WATER QUALITY ASSESSMENT OF LAKES

Section 314 of the Clean Water Act of 1987 requires that states submit a lake water quality assessment as part of their biennial 305(b) report. Six areas are to be included in the assessment. These are:

(1) An identification and classification according to eutrophic condition of all publicly owned lakes in a State.

(2) A general description of the State's procedures, processes, and methods (including land use requirements) for controlling lake pollution.

(3) A general discussion of the State's plans to restore the quality of degraded lakes.

(4) Methods and procedures to mitigate the harmful effects of high acidity and remove or control toxics mobilized by high acidity.

(5) A list and description of publicly owned lakes for which uses are known to be impaired, including those lakes which are known not to meet water quality standards or which require implementation of control programs to maintain compliance with applicable standards, and those lakes in which water quality has deteriorated as a result of high acidity that may reasonably be due to acid deposition.

(6) An assessment of the status and trends of water quality in lakes including the nature and extent of pollution loading from point and nonpoint sources and the extent of impairment from these sources, particularly with regard to toxic pollution.

The U.S. Environmental Protection Agency (EPA) has developed a guidance document (Guidelines for the Preparation of the 1990 State Water Quality Assessment (305(b) Report), February 1989) which includes a section on lake assessment reports. Kentucky's report generally complies with the guidelines suggested by the EPA.

Lake Identification

Appendix C lists publicly owned lakes for which data were available to assess trophic status. Much of this information came from lake surveys conducted by the Division of Water in 1981-1983 as part of an EPA cooperative agreement funded under Section 314 of the Clean Water Act. Kentucky received additional Section 314 funds in 1989 to update the original assessment. Lakes are being resurveyed by the Division of Water and Murray State University (under a Memorandum of Agreement) over a two year period to reassess their trophic status. The information from the 1989 surveys was used in this report. The 1992 305(b) Report will utilize the information collected from the lakes to be resurveyed in 1990. Not all of the significant publicly owned lakes in Kentucky are included in the table because data has not been collected from all such lakes. For purposes of this report, publicly owned lakes are those lakes which are owned or managed by a public entity such as a city, county, state, or federal agency where the public has free access for use. A nominal fee for boat launching charged by concessionaires may occur on some of these lakes. Lakes which are publicly owned, but restrict public access because they are used solely as a source of domestic water supply, are not included. These lakes do not qualify for federal

restoration funds under the Clean Lakes Program and were not monitored in the lake classification survey. EPA guidance suggests that all significant lakes be included in state surveys. The term "significant" is to be defined by the state so that all lakes which have substantial public interest and use would be included. For this purpose, Kentucky considers all of the publicly owned lakes it has surveyed and listed in Appendix C and also those which have not yet been surveyed, but qualify as a publicly owned lake, as significant. All of these lakes have substantial local or regional public interest and use.

Trophic Status

Lake trophic state was assessed by using the Carlson Trophic State Index (TSI) for chlorophyll *a*. This method is convenient because it allows lakes to be ranked numerically according to increasing eutrophy and also provides for a distinction (according to TSI value) between oligotrophic, mesotrophic and eutrophic lakes. The growing season average TSI (chlorophyll *a*) value was used to rank each lake. Growing season was defined as the April through October period. A distinction was made for those lakes which exhibited trophic gradients. If lakes exhibited trophic gradients or embayment differences, those areas were analyzed separately.

The chlorophyll *a* index has proven its ability to detect changes in trophic condition. For instance, Carr Fork Lake data indicated that the lake was oligotrophic in 1978, 1979, and 1980. The mean TSI for those years was 29. In 1981, the TSI was 52 which is in the eutrophic range. The index value indicated that the lake had undergone a trophic state change. Subsequent inquiries revealed that the lake had been fertilized by the Kentucky Department of Fish and Wildlife Resources to increase fish production.

While there are several other methods of evaluating lake trophic state, the accuracy and precision of the chlorophyll *a* analytical procedure (determined from Division of Water quality control data) and proven ability of the chlorophyll *a* TSI to detect changes, made it the index of choice for classifying lakes in Kentucky's program.

Chlorophyll *a* concentration data from the ambient monitoring program, and the most current chlorophyll *a* data collected during the spring through fall seasons (a minimum of 3 samples) by the U.S. Army Corps of Engineers (COE) on several reservoirs which they manage, were used to update the trophic classifications for this report. Other data were obtained from a report on a study of Lake Barkley conducted by Dr. Joe M. King of Murray State University. Data averaged from water column depths of up to 20 feet were used in calculating TSI values. Table 18 contains the trophic state rankings of lakes of 5,000 acres or more in size and Table 19 lists and ranks the trophic state of lakes less than 5,000 acres in size. Lakes which have updated classifications are in bold face type. A "+" or "-" symbol is used to indicate a trend of increasing or decreasing trophy. Trends were defined as a change of ten units from a previous TSI score. This represents a doubling or halving of Secchi disk depth and was chosen because it is a noticeable indication of change.

A summary of Tables 18 and 19 indicates that of the 99 classified lakes, 56 (56%) were eutrophic, 31 (32%) were mesotrophic, and 12 (12%) were oligotrophic. This is based on the status of the major areas of lakes and does not account for the trophic gradient that exists in some reservoirs nor the trophic status of the embayments of others. The dynamic nature of these reservoirs makes it more

Table 18

Trophic State Rankings for Lakes
5,000 Acres or Greater in Area
(by Carlson TSI (Chl *a*) Values)

Lake	TSI (Chl *a*)*	Acres
	Eutrophic	
Barkley	61	45,600
Green River	**55+**	**8,210**
Nolin	**52**	**5,790**
Kentucky	52	48,100
	Mesotrophic	
Rough River	48	5,100
Barren River	**50**	**7,205**
Beaver Creek Arm	57 (Eutrophic)	1,565
Skaggs Creek Arm	**50 (Mesotrophic)**	**1,230**
Cave Run	**45**	**8,270**
	Oligotrophic	
Cumberland	38	49,364
Lily Creek Embayment	**58 (Eutrophic)**	**144**
Beaver Creek Embayment	**54 (Eutrophic)**	**742**
Laurel River	34	4,990
Midlake-Laurel Arm	47 (Mesotrophic)	754
Headwaters-Laurel Arm	58 (Eutrophic)	316
Dale Hollow	33	4,300

*Scale: 0-40 Oligotrophic (nutrient poor, low algal biomass)
41-50 Mesotrophic (slightly nutrient rich, moderate amount of algal biomass)
51-69 Eutrophic (nutrient rich, high algal biomass)
70-100 Hypereutrophic (very high nutrient concentrations and algal biomass)

Bold Type = Updated Classifications,
+/- = upward trend (more eutrophic) or downward (less eutrophic)trend

Table 19

Trophic State Rankings for Lakes
Less Than 5,000 Acres in Area
(by Carlson TSI (Chl *a*) Values)

Lake	TSI (Chl *a*)*	Acres
	Hypereutrophic	
Reformatory	77+	54
	Eutrophic	
Swan	69	193
Arrowhead**	68	37
Fish	68	27
Spurlington	68+	36
Wilgreen	68	169
Briggs	67	18
Campbellsville City	67+	63
Jericho	67+	137
Marion County	67	21
Carpenter	66	64
Guist Creek	65	317
Kingfisher	65	30
McNeely	65	51
Buck	64	19
Kincaid	64	183
Taylorsville	64	3,050
Willisburg	64	126
Metropolis	63	36
Flat	62	38
Washburn	62	26
Doe Run	61+	51
Mauzy	61	84
Burnt Pond	60	10
Long Pond	60	56
Turner	60	61
Greenbriar	59	66
Scenic	59	18
Shanty Hollow	59	135
A.J. Jolly	58	204
Energy	58	370
Grapevine	58	50
Chenoa	57	37
Corinth	57	96
Sand Lick Creek	57	74
Beaver	56	158
Bullock Pen	56	134
Elmer Davis	56	149

Table 19 (Continued)

Lake	TSI (Chl *a*)	Acres
Spa	56	240
Boltz	55	92
Corbin	55	139
General Bulter	55	29
Morris	55	170
Herrington	54	2,940
Malone	54	826
Moffit	54	49
Carr Fork	53	710
Shelby	53	17
Carnico	53	114
Williamstown	52	300
Linville	52	273
Mill Creek (Monroe County)	51	109
	Mesotrophic	
Liberty	50	79
Long Run	50	27
Luzerne	50	55
Salem	50	99
Pennyrile	50	47
Caneyville	49	75
Hematite	49	90
Honker	49-	190
Peewee	49	360
Beshear	48	760
Fishpond	48	32
Freeman	48	160
Greenbo	48	181
Blythe	47	89
George	47	53
Loch Mary	47	135
Metcalfe County	47	22
Smokey Valley	47	36
Bert Combs	46	36
Dewey**	46+	1,100
Mill Creek (Powell County)	46	41
Wood Creek	46+	672
Laurel Creek	45	42
Buckhorn	44	1,230
Sympson	44	184
Paintsville	43	1,139
Pan Bowl	43	98
Lewisburg	41	51

Table 19 (Continued)

Lake	TSI (Chl *a*)	Acres
	Oligotrophic	
Tyner	40	87
Campton	40	26
Grayson	**39**	**1,512**
Cranks Creek	38	219
Fishtrap	**37**	**1,143**
Martins Fork	37	334
Stanford	**36**	**43**
Providence City	35	35
Cannon Creek	33	243

*Scale: 0-40 Oligotrophic 51-69 Eutrophic
41-50 Mesotrophic 70-100 Hypereutrophic

Bold Type = Updated Classifications, ** = 2 samples only,
+/- = upward (more eutrophic) or downward (less eutrophic) trend

difficult to assign them a single trophic state because their water residence times, the nature of major inflows, and their morphology can result in different trophic states in separate areas. The tables indicate that trophic gradients exist in Barren River and Laurel River lakes and that certain embayments of Lake Cumberland are eutrophic, while the main lake area is oligotrophic.

The 99 assessed lakes have a total area of 214,861 acres. Only those portions of lakes Barkley, Kentucky, and Dale Hollow lying within Kentucky were included in the total. Tennessee reports on those portions within its borders. Of the total, 57 percent (122,923 acres) were eutrophic while 29 percent (62,296 acres) were oligotrophic and 14 percent (29,642 acres) were mesotrophic.

Lake Pollution Control Procedures

Kentucky utilizes several approaches to control pollution in its publicly owned lakes. The approach chosen is dependent upon the pollutant source and the characteristics of each lake. Point sources of potential pollution are more controllable than nonpoint sources. The following procedures are routinely used to control point sources of pollution.

Permitting Program

A lake discharge guidance procedure is in effect and is applied to any new construction permit for a facility which proposes to discharge into a lake, or for any application for a lake discharge permit under the Kentucky Pollutant Discharge Elimination System (KPDES). An applicant is required to evaluate all other feasible

means of routing the discharge or to explore alternate treatment methods which would result in no discharge to a lake. As a last resort, a lake discharge may be permitted. Permits for domestic wastes require secondary treatment and a discharge into the hypolimnion in the main body of the lake. More stringent treatment may be required depending upon lake characteristics. Surface discharges are not allowed. A permit may also be denied to a prospective discharger if the discharge point is within five miles of a domestic water supply intake.

Water Quality Standards Regulations

Kentucky has not adopted specific criteria to protect lake uses. Warmwater aquatic habitat, domestic water supply (if the lake is used for this purpose), and primary and secondary contact recreation criteria are generally applicable to lakes. In specific cases, a provision in the water quality standards regulation can be utilized to designate a waterbody as nutrient limited if eutrophication is a problem. Point source dischargers to the lake and its tributaries can then have nutrient limits included in their permits.

Lakes which support trout are further protected by another provision which requires dissolved oxygen in waters below the epilimnion to be kept consistent with natural water quality.

Kentucky is not planning to adopt statewide criteria specifically for lakes. A site-specific approach to lake pollution control is more realistic and feasible.

Specific Lake Legislation and Local Initiatives

The Kentucky General Assembly has the prerogative to pass legislation to protect lakes. This has been done for Taylorsville Lake. House Joint Resolution No. 4 prohibits issuing any discharge permits which allow effluents to be directly discharged into the lake. It also prohibits issuing any permits which allow inadequately treated effluents to be discharged into contributing tributaries that drain the immediate watershed of the lake. In addition, wastewater permit applications in the basin above the lake must be evaluated to ensure that discharges will not adversely affect the lake or its uses. Other provisions provide for stringent on-site wastewater treatment requirements, promotion of nonpoint source controls, and proper management of sanitary landfills in the watershed.

Lake protection associations are not formally organized in Kentucky. This is one mechanism which has proven to be successful in preventing lake pollution in other states. Local ordinances can be passed which restrict land use activities and on-site treatment systems and lead to pollution abatement. Local grass roots opposition to activities which may degrade lakes can lead to state agency action. An example is the petition process in the state's surface mining regulations which can lead to lands being declared unsuitable for mining. Such a petition has been successfully made to protect the water quality of Cannon Creek Lake in Bell County. The lake is used as a water supply for the City of Pineville and is also used for fishing and recreation.

Lake Monitoring

Monitoring water quality in lakes is a part of Kentucky's ambient monitoring program and is described in Chapter 4. The objectives of the monitoring program are flexible so that lakes can be monitored for several purposes. These include:

- o detection of trends in trophic status
- o impacts of permit decisions
- o ambient water quality characterization
- o nonpoint source impacts
- o long-term acid precipitation impacts
- o pollution incidences such as fish kills and nuisance algal blooms
- o new initiatives such as fish tissue analysis for toxics and fecal coliform surveys in swimming areas.

Lake Restoration Plan

Kentucky has not developed a formal state Clean Lakes Program. Several states have adopted a program modeled after the federal Clean Lakes Program and have had state funds appropriated to aid in lake restoration projects. The impetus for developing these programs has been the historical importance of lakes as recreational and aesthetic resources in these states. Pollution or the potential for pollution has prompted support for state development of these programs. Pollution of lakes in Kentucky has not reached a point where there is a recognized need to develop a state program of this nature.

The Division of Water does participate in the federal Clean Lakes Program. The Natural Resources and Environmental Protection Cabinet is the state agency designated by the Governor to receive federal assistance under this program. Kentucky has received two assistance awards. One helped to fund a project which classified lakes in the state according to trophic status and assessed their need for restoration. The other award helped to fund a diagnostic/feasibility study of McNeely Lake in Jefferson County.

The Division of Water cooperated with local and federal agencies in both of these projects and prepared a grant for implementation of the restoration plan for McNeely Lake. The grant was not awarded because it was technically not eligible for assistance under federal guidelines. However, Jefferson County passed a bond issue to finance the implementation of the plan. It was completed in December of 1988. The Division will continue to monitor the lake as part of its ambient program to document water quality improvements.

The Division of Water is ready to cooperate with local agencies and other interested groups to participate in the federal Clean Lakes Program. The preparation of this assessment report is a requirement for future participation in that program.

Toxic Substance Control/Acid Mitigation Activities

Kentucky does not have publicly owned lakes which have high acidity that is caused by acid precipitation, consequently this requirement does not apply and will not be addressed.

Identification of Impaired and Threatened Lakes

Table 20 summarizes information on use support for Kentucky lakes. This information was gathered from published annual reports produced by the COE on reservoirs which they manage, from research reports by other investigators, and from Division of Water data bases. The total acres assessed are equal to the acres monitored. The analysis is based on chemical data relating to iron, manganese, dissolved oxygen problems, biological data relating to algal biomass (blooms), algae

causing taste and odor problems, macrophyte infestations, and fish kill reports. Kentucky has not derived water quality standards specifically for lakes. Consequently, criteria were developed based on other indicators of lake use support (see Table 21). One of the criteria for support of aquatic life was changed to indicate that a use was not being fully supported if the average dissolved oxygen concentration within the epilimnion was less than 5 mg/l. Previously, one value within the epilimnion below 5 mg/l would have placed a lake in a nonsupport category. Lakes were reassessed using this new criteria and this resulted in some lakes being removed from the nonsupport tables. In addition, Barren River and Cave Run lakes, which had been listed as partially supporting a domestic water supply use in the previous 305(b) Report, were removed because they are not directly used as water supplies. Their releases affect downstream uses and this is more correctly addressed in the streams and rivers assessment. This action is largely responsible for the difference between relative causes and sources in this report and the 1988 305(b) Report.

Table 20
Summary of Lake Use Support

Degree of Use Support	Assessment Basis (Monitored)	Total Assessed
Acres Fully Supporting	100,910	100,910
Acres Threatened	94,839	94,839
Acres Partially Supporting	15,362	15,362
Acres Not Supporting	3,750	3,750

Acres Assessed - 214,861
Total Kentucky Lake Acreage - 228,385

There are no known published data on the total lake acreage in Kentucky. The total reported in Table 20 is based on the Division of Water's Dam Inventory Files and the acres inventoried in the lake classification program. The assessed acres represent over 90 percent of the publicly-owned lake acreage in the state. Lakes have not specifically been classified by use in Kentucky, although proposed uses are included in revisions to Kentucky's water quality standards. These have not been formally adopted at this time. Waters not specifically listed by use in water quality regulations are generally classified for the uses of warmwater aquatic habitat, primary and secondary contact recreation, and domestic water supply at points of withdrawal. Lake use support is based on these uses. Primary contact recreation was not assessed because the primary indicator of use support (fecal coliform bacteria) was not measured as part of agency monitoring programs.

Table 21
Criteria for Lake Use Support Classification

	Uses		
	Warmwater Aquatic Habitat	**Secondary Contact Water Recreation**	**Domestic Water Supply**
Not Supporting:	At least two of the following:		
	1. Fish kills caused by water quality	1. Widespread excess macrophyte /macroscopic algal growth	1. Chronic taste and odor complaints caused by algae
		or	or
	2. Severe hypolimnetic oxygen depletion	2. Chronic nuisance algal blooms	2. Chronic treatment problems caused by water quality
	3. Dissolved oxygen average less than 5 mg/l in the epilimnion		
Partially Supporting:	1. Dissolved oxygen average less than 5 mg/l in the epilimnion	1. Localized or seasonally excessive macrophyte/ macroscopic algal growth	1. Occasional taste and odor complaints caused by algae
	or	or	or
	2. Severe hypolimnetic oxygen depletion	2. Occasional nuisance algal blooms	2. Occasional treatment problems caused by water quality
	or	or	
	3. Other specified cause	3. High suspended sediment concentrations during the recreation season	
Fully Supporting:	1. None of the above	1. None of the above	1. None of the above

Table 22
Lakes Not Supporting Uses

Lake	Use Not Supported*	Criteria	Cause	Source
Corbin	DWS	1	Nutrients	Municipal point sources and agricultural nonpoint sources
Jericho	WAH	2,3	Nutrients	Agricultural nonpoint sources
Loch Mary	DWS	2	Metals (Mn) and other inorganics (noncarbonate hardness)	Surface mining (abandoned lands)
McNeely	WAH	1,2,3	Nutrients	Municipal point sources (package treatment plants)/Inlake sediments
Reformatory	WAH	1,2,3	Nutrients	Animal holding /management areas
Sympson	DWS	1	Nutrients	Agricultural nonpoint sources
Taylorsville	WAH	1,2,3	Nutrients	Municipal point sources and Agricultural nonpoint sources

***WAH - Warmwater Aquatic Habitat, SCR - Secondary Contact Recreation, DWS - Domestic Water Supply**

Detailed information on formerly assessed lakes can be found in the report on the lake classification program entitled Trophic State and Restoration Assessments of Kentucky Lakes, which was published in 1984 by the Division of Water. Detailed information on newly assessed lakes will be included in the final report of the lake assessment project. Appendix C lists summary information on all of the lakes assessed.

Table 22 and Table 23 list lakes according to whether their uses are not supported or are partially supported. The tables indicate which criteria from Table 21 were used to determine nonsupport or partial support and the probable causes and sources for the support not being achieved. Table 24 lists those lakes which fully support their uses.

Ninety-one percent of the total acres assessed supported uses while nine percent did not fully support uses. All of the ten lakes over 5,000 acres in size fully supported uses. More than half of the small lakes fully supported their designated uses (52 of 89).

Only one of the lakes listed in this report as not supporting particular uses or as partially supporting uses, is degraded to the extent that fishing and swimming are precluded. Hazards to human health through consumption of fish or swimming in waters contaminated by bacteria were not considered as problems in any of the listed lakes. The one lake, Cranks Creek, partially supports the fishable/swimmable goals of the Clean Water Act because of low pH caused by acid mine drainage. Assessed acres which support the fishable/swimmable goals of the Act equal 214,642. Fishable/swimmable goals are partially supported in 219 acres (Cranks Creek Lake).

EPA guidance asks for a list of threatened lakes. These are defined as lakes which fully support uses now, but may not in the future because of anticipated sources or adverse trends of pollution. Table 20 indicates the total acres classified as threatened. Table 25 lists the lakes and indicates what uses are threatened and the causes and sources of the threat.

Table 26 indicates the causes responsible for nonsupport of lake uses. Nutrients cause the greatest percentage of nonsupport and affect the largest number of lakes. Nutrients can stimulate a proliferation of algae, which may cause taste and odor problems in lakes used for domestic water supplies. Dissolved oxygen can also be lowered in surface waters by very productive algal populations which stimulate microbial respiration. This may result in fish kills or decrease oxygen to levels that are not conducive to the support of healthy populations of fish. Metals are the second largest contributor to nonsupport of uses. This is largely due to iron and manganese affecting lakes used for domestic water supplies. These metals are solubilized from lake sediments under anoxic conditions and cause water treatment problems. Suspended solids (the next largest contributor to nonsupport of uses) cause several reservoirs in eastern Kentucky to not fully support secondary contact recreational uses. Major and minor impacts from these causes were not differentiated. The criteria used in the assessments would categorize these causes as major impacts. Priority pollutants (toxics) did not cause any of the lake use impairments.

Table 27 indicates the sources responsible for nonsupport of lake uses. Agricultural sources are the single source responsible for the highest percentage of use nonsupport (31%). Nonpoint sources including agriculture account for the highest

Table 23

Lakes Partially Supporting Uses

Lake	Use*	Criteria	Cause	Source
Buckhorn	SCR	3	Suspended solids	Surface mining
Briggs	SCR	2	Nutrients	Lake fertilization
Campbellsville	WAH	1	Nutrients	Agricultural nonpoint sources
Caneyville	DWS	1	Nutrients	Natural
	SCR	1	Nutrients	Natural
Carpenter	SCR	1	Shallow lake basin	Natural
Carr Fork	SCR	3	Suspended solids	Surface mining
Cranks Creek	WAH	3	pH	Mining
Dewey	SCR	3	Suspended solids	Surface mining
Fishtrap	SCR	3	Suspended solids	Surface mining
Guist Creek	DWS	1	Nutrients	Agricultural nonpoint sources
	WAH	1	Nutrients	
Herrington	WAH	1	Nutrients	Muncipal, Agricultural nonpoint sources, Septic tanks
Honker	WAH	1	Nutrients	Natural
Kincaid	WAH	1	Nutrients	Lake fertilization
Kingfisher	SCR	2	Nutrients	Lake fertilization
Laurel Creek	DWS	1	Nutrients	Natural
Laurel River (Headwaters)	SCR	2	Nutrients	Municipal point sources and Agricultural nonpoint sources
Lewisburg	SCR	1	Shallow lake basin	Natural

Table 23 (Continued)

Lake	Use*	Criteria	Cause	Source
Liberty	DWS	2	Metals (Fe and Mn)	Natural
Martins Fork	SCR	3	Suspended solids	Surface mining
Marion County	SCR	2	Nutrients	Lake fertilization
Metcalfe County	SCR	1	Shallow lake basin	Natural
Morris	DWS	1	Nutrients	Agricultural nonpoint sources
Rough River	DWS	2	Metals (Mn)	Natural
Salem	SCR	1	Shallow lake basin	Natural
Sand Lick Creek	WAH	1	Nutrients	Agricultural nonpoint source
Shelby	WAH	1	Nutrients	Agricultural nonpoint sources
Spa	WAH	1	Nutrients	Agricultural nonpoint sources
Stanford	DWS	1	Nutrients	Natural
Wilgreen	WAH	2	Nutrients	Septic tanks
	SCR	2	Nutrients	Septic tanks
Williamstown	WAH	1	Nutrients	Agricultural nonpoint sources

*WAH - Warmwater aquatic habitat, SCR - Secondary contact recreation, DWS - Domestic water supply